PATENT
Docket No. 34003.57
Customer No. 000027683

II. AMENDMENTS TO THE SPECIFICATION

Please replace paragraph [0032] with the following amended paragraph [0032]:

[0032] FIGURE 2 shows a cross section of FIGURE 1, taken through Section ~~1-1~~ 2-2 showing the mold turned with the open sections of the "U" channels (the section opposite side 13) facing upward. The sizes of the channels depend on the particular application and the nanostructures to be assembled. The length of each channel does not seem to be critical. ~~We used a~~ A mold having approximately 5,000 channels each approximately 1 millimeter in length was used. ~~Note that while we show~~ While multiple channels are shown the process will work for any number of channels, including a single channel~~.~~.

Please replace paragraph [0035] with the following amended paragraph [0035]:

[0035] FIGURE 4 shows a drawing of what a scanning electron microscopy (SEM) would show. As can be seen there are now many near-parallel straight SWNT strings 41 formed across microchannels 12 on PDMS micromold 10. Similar results were obtained by using soluble laser-grown nanotubes (diameter 1.1-1.3 μm) in a 3 mixture of chloroform/chlorobenzene. Also, the solvents are not limited to chlorobenzene and chloroform but may be various organic or inorganic solvents, which depend on the characteristics of the one dimensional nanostructures to be assembled. Although the detailed nanotube structures are difficult to resolve under SEM, the majority of freestanding nanotube strings are believed to be either small ropes or individual nanotubes, as indicated by previous atomic force microscopy (AFM) studies of soluble SWNTs. ~~We also carried out a~~ A control experiment was carried out in which a drop of blank 3:2 mixture of chloroform/chlorobenzene was placed at the open end of microchannels. No freestanding strings were found on the PDMS micromold, therefore excluding the possibility of organic solvent-induced artifaces. No detectable distortion of the PDMS micromold was observed under SEM after the experiment. It is crucial to adjust the concentration of nanotubes as well as solvents in order to minimize the aggregation of nanotubes on the PDMS micromask so as to achieve good directionality of suspended nanotubes.

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Please replace paragraph [0038] with the following amended paragraph [0038]:

[0038] It is likely that organic liquid occasionally penetrates into the original contact area between PDMS micromold and silicon substrate, because nanotubes with lengths considerably longer than the channel width can also be seen under SEM. When using larger microchannels with width ~ 4.5 pm and height ~ 1.6 μm, ~~we didn't observe~~ freestanding strings were not observed, which is in agreement with previous observations that the average lengths of soluble nanotubes are less than 4 μm.

Please replace paragraph [0040] with the following amended paragraph [0040]:

[0040] By carefully choosing the appropriate material and geometry of the micromold, solvents, substrate as well as surface functionalization, ~~it's~~ it is possible to realize length-selective assembly of two-dimensional ordered suspended nanotube strings, which could then allow transfer-printing of crossed nanotube arrays onto chemically-functionalized and/or electroactive surfaces.

Please replace paragraph [0041] with the following amended paragraph [0041]:

[0041] ~~We have~~ It was found that a higher nanotube concentration in the solvent can lead to the aggregation of nanotubes on PDMS, and decrease the directionality of nanotubes. The best results were achieved with a nanotube concentration range between $1\times10^{-3} - 1\times10^{-2}$ mg/ml using the described 3:2 mixture of chloroform/chlorobenzene. Pure chloroform appears to lower orientation efficiency of SWNTs, possibly because chloroform vaporizes too fast to allow nanotubes to adjust the direction. Tetrahydrofuran can significantly deform the PDMS stamp and appears unsuitable for assembly experiments.

Please replace paragraph [0044] with the following amended paragraph [0044]:

[0044] The micromold ~~we~~ used was PDMS, but it is thought that many other materials will work. These other materials can be silicon, polymers, ceramics and metal. The process, as discussed, can be used also for other nanostructures, such as DNA, nanowires, and the like.

Please replace paragraph [0047] with the following amended paragraph [0047]:

[0047] Elements 94 and 95 are alternatives that rely on changing the nature of the side wall functionalization of the channel to control the wetting properties of the sidewall. That would also change where the fluid would stick and where it ~~wouldn't~~ would not stick, and would allow positional control along the lengths of the channel. As will be discussed herein, it is important to place the nanotubes in known locations because the mold could then be used to transfer the nanotubes onto another structure. This process is called transfer printing of carbon nanotube arrays and will be discussed with respect to FIGURES 11-14.

Please replace paragraph [0049] with the following amended paragraph [0049]:

[0049] Using this laminar approach, it would be possible to place the nanotube solution in one channel, say channel 101, and have a different solution, that the nanotubes are more soluble in, flowing in channels 102 and 103. Alternatively, one could put the nanotubes in channel 102, put pure solvent without nanotubes in channel 103, and a different solvent of low nanotube affinity in channel 101. In either case, by bending the composite channel 104 around a corner, long nanotubes entrained in the laminar flow could be forced to poke their ends into both subchannels 102 and 103, thus spanning subchannel 101 (multiwall and short to medium length single wall nanotubes ~~aren't~~ are not flexible enough to bend sharply around corners, so traversing a corner would cause the ends of the tube to dip into both subchannels 102 and 103 and thereafter become entrained by the increased solubility of the nanotube in those solvents). Nanotubes shorter than the cross section of subchannel 101 would not be able to span that subchannel 101, and would thus stay in their original channel.

Please replace paragraph [0055] with the following amended paragraph [0055]:

[0055] The assembly technique discussed above could, in principle, apply to not only a wide range of nanotubes in their soluble or dispersible forms, including small diameter (0.7-0.8 μm) nanotubes, covalent- and noncovalent-functionalized SWNTs, monodispersed SWNTs with identical diameter and chirality, and multiwalled nanotubes, which either cannot survive the high temperature treatment or cannot be synthesized by current CVD method; but also other soluble or dispersible one-dimensional nanostructures such as nanowires, DNA, and the like as well as nanotubes made of other elements, such as boron-nitride (BN) and the like. Nanotubes include any small object of high aspect ratio, particularly rods of metal, semiconductor, or insulators; bacteria; viruses; polypeptides; or assemblies of any of these items. Such objects should be small enough such that capillary forces can move and align them, and that they can ~~e~~ be suspended in a material, such as liquid, whereby capillary forces can act upon them. Accordingly, the word nanotube herein and in the claims should be read to include such structures.

Please replace paragraph [0057] with the following amended paragraph [0057]:

[0057] The procedures described in this patent are intended to be performed at room temperature without auxiliary heat being added. But those skilled in the art will find that the concepts of this invention can be performed at various temperatures and in various ways. For example, heat can be used to speed up or otherwise control the drying of the solvent or centrifugal force can be used to help remove liquid. This heat can be in the form of an oven or a hand held dryer and can vary over the course of the drying interval. The limiting factors of how much heat should be used will depend upon the nanotube material, the stamp and the substrate with care being taken to not change the cross-section (unless of course a cross-section change is desired) and care also being taken to not change the compositional nature of the nanotubes, the stamp or the substrate. In fact, there is no reason to believe that the process will not work below room temperature, so long as there is provision for drying, or evaporating, of the solvent so as to cause the nanotubes to stretch across the defined channel. Accordingly, ~~while we speak of room temperature, that term~~ the term "room temperature" includes raised or lowered temperatures

within the boundaries that, for any given nanotube material, the temperature used does not adversely ~~effect~~ affect that material.